QUALITY-ASSURANCE PLAN FOR WATER-QUALITY ACTIVITIES IN THE MISSISSIPPI DISTRICT

U.S. Geological Survey
Open-File Report 00-xxx

QUALITY-ASSURANCE PLAN FOR WATER-QUALITY ACTIVITIES IN THE MISSISSIPPI DISTRICT

By Richard A. Rebich, Michael A. Manning, and Fred Morris, III

U.S. Geological Survey
Open-File Report 00-xxx

Pearl, Mississippi
2000

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
Charles G. Groat, Director

The use of firm, trade, and brand names in this report is for identification purposes only and does not constitute endorsement by the U.S. Government.

For additional information write to:

District Chief
U.S. Geological Survey
308 South Airport Road
Pearl, MS 39208-6649

Copies of this report can be purchased from:

U.S. Geological Survey
Branch of Information Services
Box 25286, Federal Center
Denver, CO 80225-0286

TABLE OF CONTENTS

FIGURES

TABLES

Quality-Assurance Plan for Water-Quality Activities in the Mississippi District

By Richard A. Rebich, Michael A. Manning, And Fred Morris, III

ABSTRACT

In accordance with guidelines set forth by the Office of Water Quality in the Water Resources Division of the U.S. Geological Survey, a quality-assurance plan has been created for use by the Mississippi District in conducting water-quality activities. This quality-assurance plan documents the standards, policies, and procedures used by the Mississippi District for activities related to the collection, processing, storage, analysis, and publication of water-quality data. The policies and procedures that are documented in this quality-assurance plan for water-quality activities are meant to complement the District quality-assurance plans for surface-water and ground-water activities and to supplement the Mississippi District quality-assurance plan.

1.0 INTRODUCTION

The U.S. Geological Survey (USGS) was established by an act of Congress on March 3, 1879, to provide a permanent Federal agency to perform the systematic and scientific "classification of the public lands, and examination of the geologic structure, mineral resources, and products of the national domain." The Water Resources Division (WRD) of the USGS is the Nation's principal water-resources information agency. The objectives of the WRD's Basic Hydrologic Data Program are to collect and provide unbiased, scientifically based information that describes the quantity and quality of waters in the Nation's streams, lakes, reservoirs, and aquifers. Water-quality activities in the Mississippi District are part of the WRD's overall mission of appraising the Nation's water resources.

To address quality-control issues that are related to water-quality activities, the WRD has implemented policies and procedures designed to ensure that all scientific work conducted by or for the WRD is consistent and of documented quality. The Office of Water Quality (OWQ) is responsible for providing a quality-assurance (QA) plan that documents the policies and procedures that apply to the water-quality activities in each District in the Division.

A QA plan is a formal document that describes the management policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation procedures for ensuring quality. Quality assurance, quality control, and quality assessment are all components of a QA plan. The terms are defined as follows:

Quality assurance (QA)—The systematic management of data-collection systems by using prescribed guidelines and criteria for implementing technically approved methods and policies. Quality assurance incorporates a comprehensive plan that outlines the overall process for providing a product or service that will satisfy the given requirements for quality.

Quality control (QC)—The specific operational techniques and activities used to obtain the required quality of data. Quality control consists of the application of technical procedures to achieve prescribed standards of performance and to document the quality of collected data. Quality-control data that do not meet required standards are used to evaluate and implement corrective actions necessary to improve performance to acceptable levels.

Quality assessment—The overall process of assessing the quality of environmental data by reviewing (1) the appropriate implementation of QA policies and procedures and (2) analyzing the QC data. Quality assessment encompasses both the measurable and immeasurable factors that affect the quality of environmental data. Assessment of these factors may indicate limitations that require modifications to protocols or standard operating procedures for sample collection and analysis, or that affect the desired interpretation and use of the environmental data.

Quality-assurance, quality-control, and quality-assessment systems complement each other to provide a comprehensive QA program that ensures that quality objectives are identified and integrated into all levels of water-quality activities. By integrating these components into a discipline-wide QA guidance document, the OWQ hopes to enhance water-quality data collected by the USGS by providing for the following:

- **Consistency** in data quality across all levels of the WRD;
- **Accountability** to clients, the scientific community, regulatory agencies, and the general public;
- **Comparability** of results among samples, sites, and laboratories;
- **Trace-ability** from the end product back to its origins, and to all supplementary information, through written records;
- **Application** of appropriate and documented techniques that lead to similar results time and again;
- **Representativeness** of the data in describing the actual chemical composition of the biological or physical conditions at a sampling site for a given point or period in time; and
- **Adequacy** of the amount of data obtained to meet data objectives.

1.1 Purpose and Scope

The purpose of this District QA plan for water-quality activities is to document the standards, policies, and procedures used by the Mississippi District for activities related to the collection, processing, storage, analysis, and publication of water-quality data. This plan identifies

responsibilities for ensuring that stated policies and procedures are carried out. The plan also serves as a guide for all District personnel who are involved in water-quality activities and as a resource for identifying memoranda, publications, and other literature that describe associated techniques and requirements in more detail.

The scope of this QA plan includes discussions of the policies and procedures followed by the Mississippi District for the collection, processing, analysis, storage, and publication of water-quality data. Although procedures and products of interpretive investigations are subject to the criteria discussed in this plan, some interpretive investigations may be required to have separate and complete QA plans. The policies and procedures documented in this QA plan for water-quality activities are intended to complement the District QA plan for surface-water and ground-water activities and supplement the Mississippi District QA plan.

2.0 ORGANIZATION AND RESPONSIBILITIES

Quality assurance is an active process of achieving and maintaining high-quality standards for water-quality data. Consistent quality requires specific actions that are carried out systematically in accordance with established policies and procedures. Errors and deficiencies can result when individuals fail to carry out their responsibilities. Clear and specific statements of responsibilities promote an understanding of each person's duties in the overall process of ensuring the quality of water-quality data.

2.1 ORGANIZATIONAL CHART

The Mississippi District's organizational structure is similar to those of other Districts in the Division, but different program requirements from one District to another contribute to the uniqueness of these organizational structures. The following chart illustrates the organization of Mississippi District personnel (fig. 2.1).

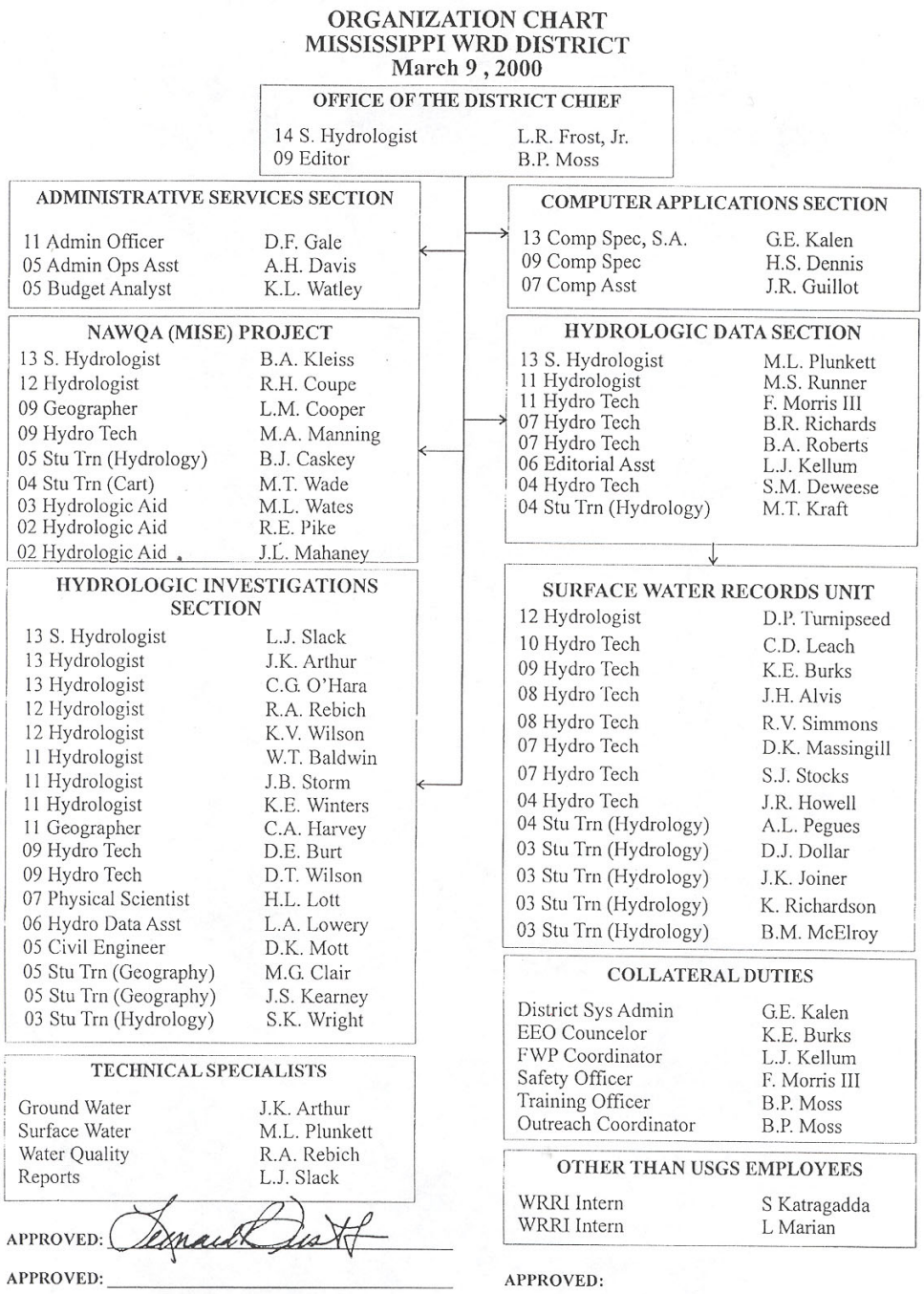


Figure 2.1. Mississippi District organizational chart, March 9, 2000.

2.2 Responsibilities

The final responsibility for the preparation and implementation of and adherence to the QA policies that are described in this QA plan lies with the District Chief (Schroder and Shampine, 1992, p. 7).

Following is a list of responsibilities for selected District personnel who are involved in the collection, processing, storage, analysis, and publication of water-quality data:

The **District Chief** and designated management personnel are responsible for:

1. Managing and directing the District program, including designation of personnel responsible for managing all water-quality activities.
2. Ensuring that water-quality activities in the District meet the needs of the Federal government, the Mississippi District, cooperating State and local agencies, and the general public.
3. Ensuring that all aspects of this QA plan are understood and followed by District personnel. This is accomplished by direct involvement of the District Chief or through clearly stated delegation of this responsibility to other personnel in the District.
4. Providing final resolution, in consultation with the Water-Quality Specialist, of any conflicts or disputes related to water-quality activities within the District.
5. Keeping subordinates briefed on procedural and technical communications from regional and Headquarters offices.
6. Participating in technical reviews of all water-quality programs on an annual basis.
7. Ensuring that all publications and other technical communications released by District personnel are accurate and comply with USGS policy.

The **District Water-Quality (QW) Specialist** or designated representative is responsible for:

1. Ensuring that water-quality activities in the District meet the needs of the Federal government, the Mississippi District, cooperating State and local agencies, and the general public.
2. Preparing and implementing the District water-quality QA plan.
3. Ensuring that all aspects of this QA plan are understood and followed by District personnel. This is accomplished by the Water-Quality Specialist's direct involvement.
4. Keeping District personnel briefed on procedural and technical communications from regional and Headquarters offices.
5. Keeping District personnel trained to accurately collect environmental and quality assurance data.
6. Participating in the development of all proposals related to water quality data collection and interpretation.
7. Participating in the preparation of project QA plans when necessary.
8. Participating in technical reviews of all District water-quality programs on an annual basis.
9. Ensuring that all publications and other technical communications released by the District that relate to and include water-quality information are accurate and comply

with USGS policy.

10. Ensuring that the District QA plan is reviewed and revised at least once every 3 years to document current responsibilities, methodologies, and ongoing procedural improvements.

The **District Water-Quality (QW) Coordinator** is responsible for:

1. Entry of all station Site-Inventory File information, field data, and QA data that meet USGS standards into QWDATA.
2. Review and verification of field data and QC data entered into QWDATA.
3. Retrieval of field data, QC data, and laboratory accounting data when requested by USGS personnel, cooperators, and others upon discretionary approval by the QW Specialist.
4. Maintenance of separate QA data base.
5. Reviewing data quarterly for completeness and prior to publication (data will be checked for errors and to ensure that all previous updates exist in NWIS).
6. Participate in quarterly project reviews when requested.
7. Work with the District QW Specialist to ensure that District personnel are aware of the latest water-quality data-collection techniques and are properly trained.

The **project chief** is responsible for:

1. Managing and directing the project's field and laboratory water-quality activities;
2. Ensuring that the project's field and laboratory water-quality activities meet the needs of the Federal government, the Mississippi District, cooperating State and local agencies, and the general public;
3. Ensuring that all aspects of this QA plan that pertain to the project's field and laboratory water-quality activities are understood and followed by project personnel;
4. Obtaining guidance, as appropriate, for project quality-assurance/quality-control (QA/QC) activities from the District QW Specialist;
5. Ensuring that QA/QC activities are properly carried out by the project staff;

2.3 References Used for the Organization and Responsibilities Section

The following table lists reports and(or) memoranda referred to in this section. For a complete citation, refer to Section 13.0 of the report.

Table 2.3. Summary of references for organization and responsibilities related to quality assurance

Reference	Subject
Schroder and Shampine, 1992	Guidelines for preparing a quality-assurance plan.
Shampine and others, 1992	Integrating quality assurance into project work plans.

3.0 PROGRAM AND PROJECT PLANNING

The District Chief has primary responsibility for overall District program planning and is responsible for ensuring that District projects are supportive of District and national priorities. All water-quality projects require review and approval prior to the commencement of work. Quality-assurance requirements should be integrated into the project proposal. Whether or not a separate QA plan will be required for a water-quality project will depend on the complexity of the work, the needs of the District or cooperator, or other criteria as described in Shampine and others (1992).

3.1 Project Proposals

Project proposals are developed at the local level in response to requests by cooperating agencies, needs recognized by the WRD in working closely with other agencies, or national programs. District proposals conform to the format required by the Southeast Region.

Each proposal must (l) state the problem or need for the study, (2) define objectives—what will be done to help solve the problem, and (3) define the approach—how work will be done to accomplish the objectives. The approach consists of a detailed outline of the data-collection activities to be carried out (if new data are needed), the QA plans, the QC information needed, and the analytical laboratories to be used. Project report plans, safety issues, cost estimates, time schedules, and personnel requirements also are addressed. Consultation with regional and divisional specialists is encouraged in the preparation of proposals and in the execution of projects.

Review of project proposals is given high priority. Project proposals that have water-quality components are reviewed by the appropriate District Chief, Supervisor, and QW Specialist and, at the discretion of the District Chief, may be sent to other Districts for additional review. The Southeast Region provides final review and approval of all project proposals.

3.2 Project Work Plan

Project work plans are developed from approved project proposals. The District requirements for the content, review, and revision of work plans are outlined below.

The project chief prepares a detailed work plan that identifies all project work elements and the related technical methods and approaches that are necessary to satisfy project objectives. The work plan links project personnel, tasks, and functions with associated funds and indicates the projected dates for on-time completion of project elements and, ultimately, the project. Work plans for water-quality programs and projects, including programs and projects with water-quality components, should clearly state how the District's "Quality-Assurance Plan for Water-Quality Activities" will be implemented.

Descriptions of the methods and approaches to be used to complete the technical elements of

the project are required and include, for example, the design of environmental sample collection to meet the study objectives. The plan lists the environmental sampling locations and frequency, a description of the sample types and their expected uses, laboratories used, and descriptions of laboratory tests.

Work plans also include a description of the design of QC sampling that is required to document bias and variability in the environmental data. The work plan lists QC sample types, the frequency of collection, and their intended uses. The types of QC samples that typically are collected include blanks and spikes to estimate bias and replicates to estimate variability (Mueller and others, 1997).

Work plans state anticipated methods for data analysis and presentation, including report plans. Accurate cost estimates are needed for personnel, materials, and services related to planned completion dates for properly budgeting the project. Assuring the availability of project personnel is often difficult and can impose serious constraints on completing project tasks; therefore, District management should be consulted to ensure adequate staff resources and to avoid the over-commitment of individuals to multiple projects. The project timeline lists major project elements and planned completion dates. Project work plans are reviewed by the appropriate District personnel (supervisor and QW specialist; District Chief when appropriate).

3.3 Project Review

Project reviews are conducted periodically by District management, technical advisors, or discipline specialists to ensure compliance with the project work plan or proposal. Project reviews are used to ensure that data collection, analysis, and reporting are being done in accordance with the work plan and with broader District policies and requirements. Quality-assurance activities with respect to project reviews are outlined in the next section.

3.3.1 Review Schedules

The District has developed and implemented an annual review schedule for evaluating the technical development and progress of water-quality programs and projects. Regularly planned reviews ensure that water-quality programs or projects are conducted efficiently to produce quality products on time. Informal reviews are part of ongoing quality assurance, whereby problems and related issues are addressed as they arise.

3.3.2 Review Documentation

The District has developed a method for documenting program and project reviews. The following information should be included in program and project review documentation:

- Date of review
- Names of reviewers and(or) attendees
- Responses to recommended action items from the last review
- Status, plans, and problems with data collection, data analysis, and report writing

- Major findings
- Cooperator/customer contacts
- Project-related training needs
- Recommended follow-up or action items
- Date for next review

The District archives all review comments that address the presence or absence of project deficiencies, all actions or recommendations for fixing deficiencies, or documentation explaining why a fix cannot be made. Project review comments are maintained and archived by the supervisor of the project chief.

3.4 References Used in the Program and Project Planning Section

The following table lists reports and(or) memoranda referred to in this section. For a complete citation, refer to Section 13.0 of the report.

Table 3.4. Summary of references for program and project planning

Reference	Subject
Mueller and others, 1997	Example of QC sample design used by NAWQA for surface-water sampling.
Shampine and others, 1992	Integrating quality-assurance into project work plans.

4.0 WATER-QUALITY LABORATORIES

Two of the most critical issues for a long-term, national water-quality program are data comparability and data consistency. Because of the inherent variability among laboratories, one of the best ways to provide comparability and consistency is to use a single laboratory as much as is practical.

4.1 Selection and Use of an Analytical Laboratory

The National Water Quality Laboratory (NWQL) was established as the laboratory to meet the needs of the WRD, and it is the required laboratory for use in all WRD national water-quality programs (WRD Memorandum 92.036). However, there are conditions for selecting a laboratory other than the NWQL.

4.1.1 Selection

Contract or cooperator laboratories can be used when the cooperative agreement designates a laboratory other than the NWQL or when analytical services are required that cannot be provided by the NWQL. Research laboratories can be used for developing analytical techniques or to provide data for research purposes, and these laboratories are generally

exempt from approval requirements that other laboratories must meet (WRD Memorandum 92.035; OWQ Technical Memorandum 98.03). District laboratories generally can be used when analyses must be done within a few hours of sample collection and cannot be done conveniently in the field.

4.1.2 Requirements for Use

All laboratories that provide analytical services to the WRD for non-research purposes must meet the requirements of the WRD, as described in WRD Memorandum 92.035, before any analytical data can be stored in the WRD National Water Information System (NWIS) data base (discussed in Section 10) or published by the WRD. Laboratories affected by this policy include those that provide chemical, biological, radiochemical, stable isotope, or sediment analytical services. The District QW Specialist is responsible for assuring that all laboratories providing analytical services to the District have met the requirements for approval. These laboratories must do the following:

1. Use approved and published analytical methods—Analytical methods must be approved and published by one of the following sources: USGS; U.S. Environmental Protection Agency (USEPA); American Public Health Association, American Water Works Association, and Water Environmental Federation (Standard Methods); or American Society for Testing and Materials (ASTM). The publication of the method must include documentation for the analytical techniques and chemical processes plus the expected data quality. If a specific analytical method not published by the sources listed above is requested for a specific project, it is the responsibility of the WRD office requesting the analysis to have the method approved based on requirements specified in WRD Memorandum 82.028 before the analytical data from this method are published and(or) stored in the USGS national data base.
2. Have standard operating procedures (SOP's) for analytical methods—All analytical methods must have documented SOP's that are approved in accordance with procedures contained in the laboratory QA plan.
3. Have an approved laboratory QA plan—The laboratory must have an approved QA plan that is supplied to WRD customers upon request. The laboratory QA plan should provide internal guidance and documentation that will ensure the laboratory is operating under a standardized, rigorous QA program and is producing analytical results of a known and documented quality. The laboratory QA plan should describe QA activities, QC procedures and requirements, performance acceptance criteria, and required corrective actions that will be taken if the criteria are not met.
4. Have a documented QC program that provides the data necessary to continuously track the bias and variability of analytical data. All QC information, such as QC charts, analysis of laboratory QC samples, calibration records, and analyst bench logs should be maintained for at least 3 years and be available to WRD customers.
5. Demonstrate the ability to provide the analytical services required—Laboratories can demonstrate the ability to provide the required analytical services by participation in existing USGS or non-USGS certification/evaluation/round-robin programs or by documentation of similar projects (OWQ Technical Memorandum 98.03). The USGS Standard Reference Sample (SRS) program is required for analytes in the SRS samples.

4.2 Laboratories Used by the District

The laboratories used for analytical services by District projects are shown in table 4.2. The analyses provided, the dates used, and the person who has been the primary contact at the laboratory also are provided in the table.

Table 4.2. Laboratories used for District projects

Project	Analytical laboratory	Analyses provided (by general category)	Laboratory contact	Dates used
NAWQA	NWQL	Chemical, biological	Ref: NWQL web page of contacts	1994 to present
NAWQA	Louisiana District	Sediment	Cheryl Joseph	1994 to present
NAWQA	Kansas District	Pesticides	Mike Thurman	1994 to present
DEC	Louisiana District	Sediment	Cheryl Joseph	1985 to present
Tenn.-Tom waterway	Louisiana District	Sediment	Cheryl Joseph	1985 to present
MSEA	Kansas District	Pesticides	Mike Thurman	1996 to present
MSEA	QWSU	Nutrients	Connie Geller	1996 to present
MSEA	Louisiana District	Sediment	Cheryl Joseph	1996 to present
GW sampling	QWSU	Chemical	Connie Geller	1980's to present
Coastal	QWSU	Chemical	Connie Geller	1999 to present

4.3 Documentation for Laboratories Used by the District

The intent of this section is to provide a single, organized location for information about the laboratories used by the District. In this section, the District can identify specific references, locations, methods of access, and contacts for the documentation and data required from each laboratory.

4.3.1 National Water-Quality Laboratory

1. Methods used—The NWQL uses approved methods for determination of organic, inorganic, and radioactive substances in water, sediments, and biological tissues. The methods used include methods approved by the USGS, USEPA, the American Public Health Association, the American Water Works Association, the Water Environmental Federation, and the ASTM. A list of some analytical methods currently used at the NWQL can be found on the World Wide Web at http://www.nwql.cr.usgs.gov/Public/ref_list.html. Other analytical methods from the USEPA that are currently used at the NWQL can be found on the World Wide Webb at http://www.epa.gov/epahome/publications.htm. Analytical methods from the ASTM that are currently used at the NWQL can be found on the World Wide Web at http://www.astm.org.
2. QA plan—The NWQL quality-assurance plan is contained in Pritt and Raese (1995). A copy of this report can be obtained by sending an email request to nwqlqc@usgs.gov.
3. QC program—Quality control at the NWQL is monitored by three programs: (1) the internal blind sample program, (2) the external blind sample program, and (3) bench level QC samples. Information about the internal blind sample program and bench level QC samples can be obtained by sending an email request to nwqlqc@usgs.gov . Information

about the external blind sample program can be found at the following World Wide Web location: http://btdqs.usgs.gov/bsp/Fact.Sheet.html.

4. Performance evaluation studies and certification programs—The NWQL participates in performance evaluation studies and laboratory certification programs. A list of the current programs and a description of each can be found by sending an email request to nwqlqc@usgs.gov .
5. Laboratory reviews—External agencies and customer organizations audit the NWQL to assess analytical methods and QA/QC programs. A table of audits that shows the year reviewed, reviewing agency, and purpose of the review can be obtained by sending an email request to nwqlqc@usgs.gov .
6. Miscellaneous services—Information about and access to other services offered by the NWQL can be found on the World Wide Web home page at http://www.nwql.cr.usgs.gov/USGS/profile.html. The services offered include but are not limited to the following:

Biological unit
Chain-of-custody procedures
Contract services
External performance evaluations
Laboratory services catalogue
Methods Research and Development Program
Organic spike kits
Publications
Quality assurance of selected field supplies
SPiN (schedules, parameters, and network record)
Technical memoranda

4.3.2 Quality of Water Service Unit (QWSU) Laboratory, USGS Florida District, Ocala, FL

1. Methods used—See Comprehensive Quality Assurance Plan, 1999, Plan #910161G: Table 5.1 and Section 8.0.
2. QA plan— See Comprehensive Quality Assurance Plan, 1999, Plan #910161G.
3. QC program— See Comprehensive Quality Assurance Plan, 1999, Plan #910161G: Section 11.0. Available in FL and MS Districts.
4. Certification programs—State of Florida; USGS-BQS; USGS-OWQ; USGS Blind Sample Project; USGS Standard Reference Water Sample Program; EPA's Water Pollution Performance Evaluation Program; USGS National Field Quality Assurance Program.
5. Laboratory reviews—refer to Blind Sample Project, WRI 99-4057; reviewed by BQS and OWQ staff every 3 years–scheduled Summer 2000; State of Florida HRS review once per year (certificate).

4.3.3 USGS Sediment Laboratory, USGS Louisiana District, Baton Rouge, LA

1. Methods used—Standard methods for sediment concentration and particle size distribution analyses; TWRI Series Laboratory Theory and Methods for Sediment Analyses, Book 5, Chapter C1;

2. QA plan— OFR 91-467 QA Plan for Analysis of Fluvial Sediment by Laboratories of the USGS; Louisiana District QA plan for sediment (available in LA and MS Districts).
3. QC program— QA plans already mentioned; SLEDS program; QC data can be pulled with every sample run.
4. Certification programs—Done every year in October by SLQAP of BQS; performance results can be viewed on the World Wide Web.
5. Laboratory reviews—Done every 3 years (next is scheduled Summer 2000) by BSP and OWQ personnel; review document is located in the LA District (contact Cheryl Joseph for results).

4.3.4 USGS Organic Geochemistry Research Laboratory, USGS Kansas District, Lawrence, KS

1. Methods used—See OFR 98-634 and handout available in MS District.
2. QA plan— See OFR 98-634 and handout available in MS District.
3. QC program— See OFR 98-634 and handout available in MS District. Contact KS District (Betty Scribner) for QC sample analyses.
4. Certification programs—Will start with NWQL in Fall 2000 (will send in samples, blanks, and spikes for comparison on the order of 6 times per year). Inspected by EPA in 1995 and 1998.
5. Laboratory reviews—Inspected by EPA in 1999 (designated as research lab); safety inspection April 2000 and again about every 3 years; reviewed by OWQ, BQS, and regional staff in 1999.

4.4 References Used for the Water-Quality Laboratories Section

The following table lists reports and(or) memoranda referred to in this section. For a complete citation, refer to Section 13.0 of this report.

Table 4.4. Summary of references for selecting and using water-quality laboratories

Reference	Subject
OWQ Technical Memorandum 98.03 (USGS)	Policy for the evaluation and approval of production analytical laboratories.
Pritt and Raese, 1995	Quality assurance/quality control manual NWQL.
WRD Memorandum 82.028 (USGS)	Acceptability and use of water-quality analytical methods.
WRD Memorandum 92.035 (USGS)	Policy for approval of all laboratories providing analytical services to the WRD for non-research purposes.
WRD Memorandum 92.036 (USGS)	Policy of the WRD on the use of laboratories by national water-quality programs.

5.0 SAMPLE PROCESSING AREA AND FIELD VEHICLES

The District maintains a sample preparation area and field vehicles for use in preparing equipment for field activities, processing samples, and preparing samples for shipment to analytical laboratories. This section documents the District's criteria for maintaining and

operating these facilities.

5.1 Sample Processing Area

The Mississippi District sample processing area consists of a staging area, and responsibility for maintaining the space and providing equipment and supplies rests with project personnel who use the space. The area is used to support water-quality activities by providing space for field instrumentation maintenance and calibration, preparation for sample collection, and QA for these activities. The area is maintained with a supply of instruments, equipment, and expendable supplies needed by field personnel for water-quality sample collection and analysis.

5.1.1 Facility

The District maintains a sample processing area located in the Mississippi District office. The sample processing area contains laboratory benches, glassware, sinks, chemical storage cabinets, and other equipment and instruments listed in table 5.1.1. The QW Specialist and project chiefs have responsibility for maintenance of the sample processing area and QA of the equipment and instruments.

Table 5.1.1. Equipment and instruments available and quality assured in the Mississippi District sample processing area

[OWQ, Office of Water Quality; NA, not applicable]

Laboratory equipment	Quality assurance
Laboratory balance	Calibration checked annually
Refrigerator at 4 °C	Temperature monitored daily.
Fume hood	Maintained per manufacturer's instructions.
Supply of deionized water	Maintained per OWQ Tech. Memo 92.01.
Ventilated acid cabinets	NA
Wash sink with drying rack	NA
Vacuum pump	NA
Drying oven	Calibration monitored weekly.
Autoclave	Maintained per manufacturer's instructions.
UV sterilizers	NA
Incubators	Maintained per manufacturer's instructions.
Freezer	Temperature monitored weekly.
Lab pH and specific conductance meter	Calibrated each use

5.1.2 Procedures

The sample processing area is managed by the QW Specialist, project chiefs, and field personnel. This group is responsible for maintaining the area, supplies, and equipment listed above. The QW Specialist maintains QA records of laboratory equipment and supplies, such as calibration standards, chemical reagents, sample preservatives, and sample bottles that are provided to field personnel. Each project chief and field personnel is responsible for repair and maintenance of their project's water-quality equipment and instruments. The Hazardous Waste Coordinator oversees the District waste-disposal practices to ensure that procedures are in compliance with State and Federal regulations. The operation of the unit is reviewed annually by the QW Specialist and every 3 years by the OWQ.

5.1.3 Equipment and Supplies

It is the responsibility of project chiefs and field personnel to order, store, and quality assure the following field equipment and supplies as needed.

Table 5.1.3. Summary of information on supplies, equipment, and instruments in the Mississippi District
[RP, responsible party; NIST, National Institute of Standards and Technology]

Supplies, equipment, and instruments	Source and guidelines for QA	Responsible party
Sample bottles	Purchase from Water- Quality Service Unit (QWSU) in Ocala, Fla.; NWQL	Project chiefs, field personnel
Coolers/shipping containers	Local	Project chiefs, field personnel
Sample preservatives	QWSU; NWQL	Project chiefs, field personnel
pH calibration standards	Commercially prepared buffers, traceable to NIST Standard Reference Material; QWSU	Project chiefs, field personnel
Specific conductance calibration standards	QWSU	Project chiefs, field personnel
Blank water for QA	QWSU; NWQL	Project chiefs, field personnel
Deionized water	Local – Continental Water Supplies	QW Specialist, project chiefs, field personnel
Isokinetic water-quality samplers	HIF; FISP	QW Specialist, project chiefs, field personnel
Splitting devices	Geo-tech; Ocala – churns, cones	QW Specialist, project chiefs, field personnel
Specific conductance meters	HIF; commercial suppliers	QW Specialist, project chiefs, field personnel
pH meters	HIF; commercial suppliers	QW Specialist, project chiefs, field personnel

5.2 Water-Quality Field Vehicles

Field vehicles refer to all vehicles that are designed, designated, and outfitted for use during water-quality sample-collection and processing activities at or near sample-collection sites. The District maintains vehicles designated for water-quality sample collection and processing. If a non-designated vehicle must be used for water- quality work, portable processing and preservation chambers are used for sample processing, and extra QC samples are collected to document that the data have not been compromised. Refer to the National Field Manual for guidelines on procedures for collecting and processing water-quality data (USGS Techniques of Water-Resources Investigations (TWRI), book 9, chaps. A1-A9).

A field vehicle is designated as a water-quality field vehicle when it meets criteria to maintain a non-contaminating environment for the constituents being sampled. The work area must be maintained to eliminate sources of sample contamination. Specifications for vehicles used when sampling for water-quality constituents are discussed by Horowitz and others (1994) and in the National Field Manual (Wilde and others, 1998b, TWRI book 9, chap. A2.3) and include the following:

- Materials used for cabinets, storage, and work surfaces must be easy to maintain, made of or covered with non-contaminating materials, and such that they can be cleaned with water or solvents as appropriate. Cargo must be restricted to equipment and supplies related to water-quality sample collection unless stored in a separate compartment. No potentially contaminating equipment or supplies, such as sounding weights, solvents, or fuel, may be transported in the interior compartment of the vehicle.
- A dust barrier exists between the cab and work area of the vehicle.

Field personnel are responsible for vehicle maintenance, for maintaining the suitability of the vehicle for water-quality sample collection, and for keeping the vehicle supplied.

5.3 References Used for the Sample Processing Area and Field Vehicles Section

The following table lists reports and(or) memoranda referred to in this section. For a complete citation, refer to Section 13.0 of the report.

Table 5.3. Summary of references for the sample processing area and field vehicles

Reference	Subject
Branch of Operations Technical Memorandum 91.01 (USGS)	Safety Chemical-Hygiene Plan.
Horowitz and others, 1994	Protocol for collecting and processing samples for inorganic analysis.
NWQL Memorandum 92.01 (USGS)	Availability of equipment blank water for inorganics and organics.
OWQ Technical Memorandum 92.01 (USGS)	Distilled/deionized water for District operations.
OWQ Technical Memorandum 92.06 (USGS)	Recommended guidelines for shipping samples to the NWQL.
Wilde and others, 1998b (National Field Manual, TWRI book 9, chap. A2.3)	Guidelines for field vehicles.

6.0 WATER-QUALITY INSTRUMENTS

The Mississippi District complies with the WRD policy of providing personnel with high-quality field instruments and equipment that are safe, precise, accurate, durable, reliable, and capable of performing required tasks (WRD Memorandum 95.35). Accordingly, appropriate instruments for use in water-quality projects in the District should be selected based upon the specifications described in the USGS "National Field Manual for the Collection of Water-Quality Data" (TWRI book 9, chaps. A1-A9) and the requirements of the project. The Hydrologic Instrumentation Facility (HIF), which provides analyses of precision and bias for water-quality instruments, also should be consulted for recommendations when appropriate. Consultation with QW Specialist should be done if project personnel need assistance with the selection or use of equipment.

All instruments used by District personnel for water-quality measurements are to be properly operated, maintained, stored, and calibrated. For correct operation of any field or laboratory equipment, the manufacturer's operating guidelines should be carefully followed. Calibration, battery checks, and operating efficiency of the instruments will be determined prior to each field trip and before each use. Field calibration data will be recorded on each field form for review by the project chief. Records of periodic inspection, maintenance, and repairs will be maintained with the equipment. Records of service warranties, service manuals, and operating instructions will be retained on file by the project chief. Information regarding the preparation and storage of calibration standards is provided in Section 5.0 of this QA plan.

Thorough documentation of all calibration activities associated with water-quality data collection is a critical element of the District QA program. Calibration and maintenance records of field equipment and lab equipment, including the manufacturer, make, model, and serial or property number are to be kept in designated notebooks in the District sample processing area. Information that is required to be included with the calibration and maintenance log and/or field records includes the date, initials, results of calibration or equipment check, and any actions taken. Calibration and maintenance records are checked for completeness and accuracy.

Table 6.0 provides summary information regarding the calibration methods, acceptance criteria, calibration frequency and location, responsible persons, and references for specific instructions for the calibration and use of water-quality instruments to measure selected parameters in the Mississippi District.

Table 6.0. Summary of calibration information for water-quality instruments used to measure selected parameters in the Mississippi District

[NIST, National Institute of Standards and Technology; RP, responsible party; TWRI, Techniques for Water-Resources Investigations]

Parameter	Calibration method used	Acceptance criteria and response if not acceptable	Calibration frequency and location	Responsible person	Reference for calibration and use
Temperature	NIST-certified thermometer	Acceptable range - within 3 or 5 percent Response – repair or replacement	Semi-annually in laboratory.	Field personnel	Wilde and Radtke, 1998 (TWRI book 9, chap. A6.1); see manufacturer's instructions.
Specific conductance	At least two standards, bracketing expected values	Acceptable range - within 3 or 5 percent Response – cleaning, repair, or replacement of probe	Daily in field, if appropriate, prior to taking measurements.	Field personnel	Wilde and Radtke, 1998 (TWRI book 9, chap. A6.3); see manufacturer's instructions.
pH	Two-point calibration, bracketing expected values	Acceptable range - calculated slope must be within 5 percent of theoretical slope Response - cleaning or replacement of probe	Daily in field, if appropriate, prior to taking measurements.	Field personnel	Wilde and Radtke, 1998 (TWRI book 9, chap. A6.4); see manufacturer's instructions.
Dissolved oxygen	Air calibration in water	Acceptable range - within 3 or 5 percent Response - change membrane or replace probe	In field or laboratory, as appropriate, prior to taking measurements.	Field personnel	Wilde and Radtke, 1998 (TWRI book 9, chap. A6.2); see manufacturer's instructions.
Barometric pressure	Mercury barometer; sent in for calibration by local supplier	Acceptable range - within 5 millimeters Hg Response - replacement	Quarterly	Field personnel	See manufacturer's instructions.
Depth, turbidity	Standard methods	Manufacturer's range of acceptance	Quarterly	Field personnel	See manufacturer's instructions.

6.1 References Used for the Water-Quality Instruments Section

The following table lists reports and(or) memoranda referred to in this section. For a complete citation, refer to Section 13.0 of the report.

Table 6.1. Summary of references for water-quality instruments

Reference	Subject
Wilde and Radtke, 1998 (TWRI book 9, chap. A6)	Calibration of water-quality instruments.
WRD Memorandum 95.35 (USGS)	Instrumentation plan for the WRD and the hydrologic field instrumentation and equipment policy and guidelines.

7.0 SITE SELECTION AND DOCUMENTATION

Deciding where to sample is an important initial step toward achieving project objectives and meeting District QA/QC requirements. Once a site is selected, thorough documentation, usually in the form of a station description, is required.

7.1 Site Selection

Site selection for sampling is important to the validity of water-quality data. Selection of a suitable site can be made only after considering a number of factors, including the need for information in a particular location, the suitability of a site for sampling, and its accessibility and safety. Specific guidelines for site selection are contained in Wilde and others (1998a, chap. A1). The project chief is responsible for the selection of sampling sites, after consultation with the QW Specialist and the Surface-Water or Ground-Water Specialist, as appropriate.

7.1.1 Surface Water

If possible, water-quality stations are located at or near streamflow-gaging stations. If this is not possible, the water-quality station should be located where the stream discharge can be measured and water samples can be collected at all stages of flow to be monitored. If the water-quality station is located too close downstream from either the confluence of two or more streams or a point source of pollution, the collection of a representative sample may be difficult because of incomplete mixing. Under such conditions, the criteria for the minimum number of vertical transects sampled may need to be increased, and lateral mixing should be documented with cross-sectional surveys at various stages.

7.1.2 Ground Water

The selection of wells for ground-water sampling is dependent on many variables, including location, depth and accessibility of the well, type of well completion, availability of geologic and water-use information, and sampling purpose(s). If suitable existing wells cannot be found, new wells will need to be installed.

7.1.3 Wet and Dry Deposition

Selection of sites for collection of atmospheric deposition were mandated by documentation and qualified personnel of the National Atmospheric Deposition Program.

7.2 Site Documentation

The project chief constructs a site file containing descriptive information on location, conditions, purpose, and ancillary information for all new water-quality data-collection sites (Schroder and Shampine, 1995). Much of this information also is stored electronically in computerized site files maintained by the QW Coordinator, who is also responsible for assuring that the site file is maintained for each data-collection site. Archiving of this information is discussed in Section 10.4.

7.2.1 Surface Water

A station description is prepared for each water-quality station that is sampled on a regular or periodic basis. Sites established at existing surface-water gaging stations commonly will need only supplemental information to complete the description. Other surface-water sites, such as lakes, estuaries, and coastal waters, may require varying amounts of supplemental information to complete the station descriptions. Normally, the minimum electronically stored information required for a surface-water station record is dictated by the National Water Information System (NWIS) software used by the District. The minimum information required for establishing electronic files in NWIS for surface water is listed in table 1-1 in Wilde and others (1998a, chap. A1).

7.2.2 Ground Water

A well file (analogous to a surface-water station description) is prepared for each well that is sampled on a regular or periodic basis. Normally, the minimum electronically stored information required for a ground-water-quality site is dictated by the NWIS software used by the District. The minimum information required for establishing electronic files in NWIS is listed in table 1-4 in Wilde and others (1998a, chap. A1). Paper documents, such as agreements for use of the well between the well owner and the USGS, also should be stored in the well file.

7.2.3 Wet and Dry Deposition

Site documentation is maintained according to documentation provided by the National Atmospheric Deposition Program.

7.3 References Used for the Site-Selection and Documentation Section

The following table lists reports and(or) memoranda referred to in this section. For a complete citation, refer to Section 13.0 of the report.

Table 7.3. Summary of references for site selection and documentation for water-quality programs

Reference	Subject
Schroder and Shampine, 1995	Guidelines for documenting new water-quality data-collection sites.

8.0 SAMPLE COLLECTION AND PROCESSING

Water-quality data collected by the USGS are used by agencies throughout the Federal, State, and local levels to guide their decisions concerning the appropriate and efficient management of water resources for the Nation. Water-quality data are collected as part of such Federal programs as the National Stream-Quality Accounting Network (NASQAN) and the National Water-Quality Assessment (NAWQA) Program, as well as cooperative projects jointly funded by local or State agencies, and are a vital component of water-resources activities performed by the USGS and the Mississippi District.

The primary objective in collecting a water-quality sample is to obtain environmental data that are representative of the system that is being studied. Sampling and processing techniques for specific constituents may vary according to the general class of compound, such as inorganic or organic chemicals. If incorrect sampling procedures produce a non-representative sample, or if the sample is contaminated or degraded before analysis can be completed, the value of the sample is limited and the data are questionable. Therefore, compliance with documented and technically approved sample-collection and processing protocols is critical to ensuring the quality of water-quality data.

It is the policy of this District that all personnel involved in collecting and processing water-quality data will be adequately informed and trained regarding water-quality data-collection and processing procedures established by the WRD. Because of rapid changes in technology, however, new and improved methods for sample collection and processing are continually being developed. All District personnel who are involved in water-quality sampling must be aware of changing requirements and recommendations. The QW Specialist is responsible for providing current information to field personnel on the correct protocols to follow in collecting and processing water- quality samples.

8.1 Constituents in Water

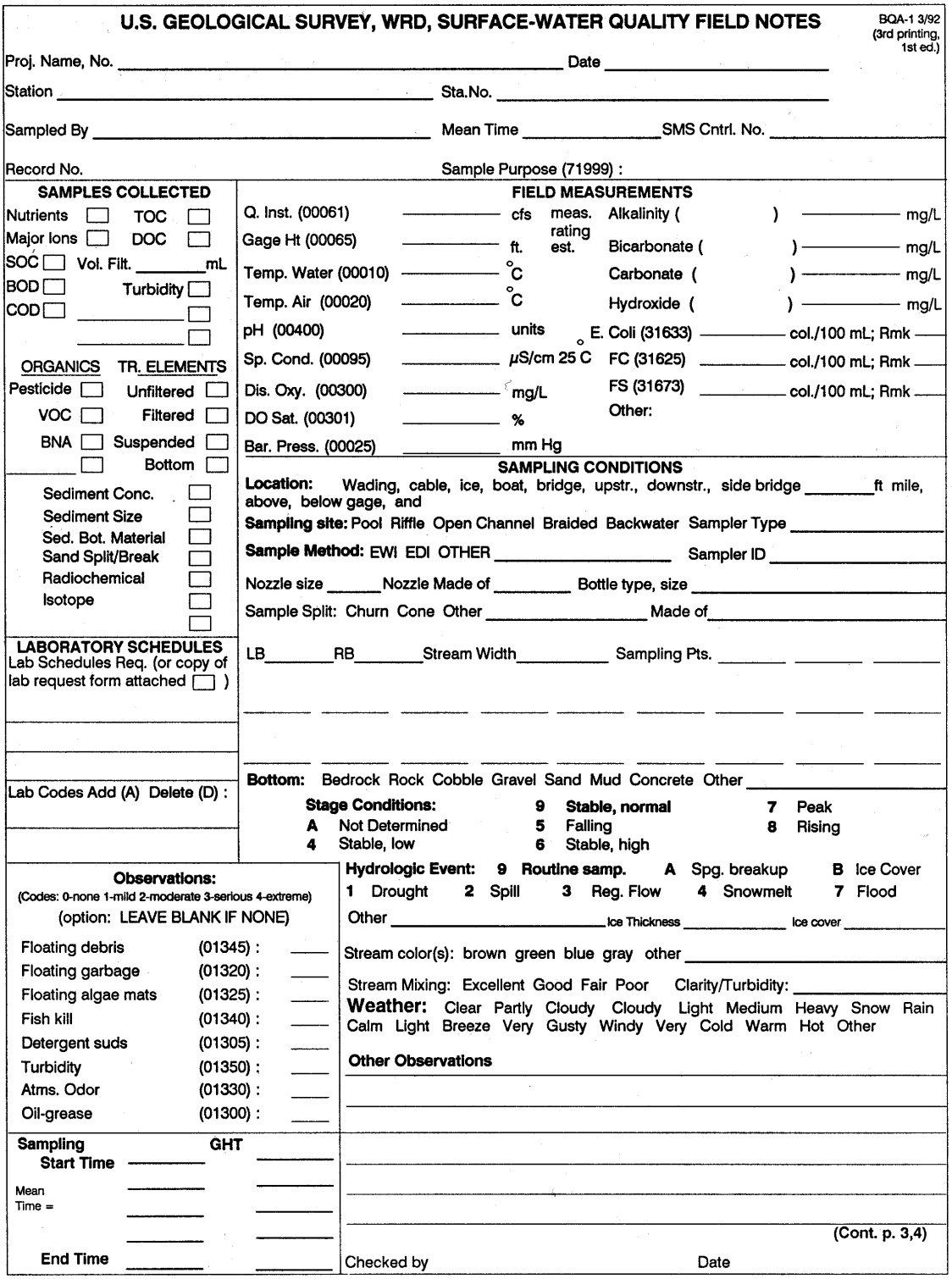
Most studies that are designed to evaluate the water quality of an aquatic system are based upon analyses of physical and chemical parameters associated with the water. Physical parameters generally are measured in the field, whereas most chemical parameters require laboratory analysis. This section of the QA plan includes an overview of relevant District and WRD policies, as well as references for specific procedures pertaining to the measurement of field parameters and the collection and processing of samples for water-quality analysis. Information in this section is drawn primarily from the National Field Manuals—a series of USGS technical manuals (TWRI's) which describe in greater detail the recommended and

required policies and procedures for collecting and processing water-quality samples in the WRD. Additional sources of information include manuals published by the NAWQA Program (Shelton, 1994; Koterba and others, 1995). The project proposal and work plan also should be consulted for specific guidelines for field personnel regarding details of sample collection and processing.

8.1.1 Field Measurements

Routine field measurements include streamflow or flow rate, temperature, dissolved-oxygen (DO) concentration, specific conductance (conductivity), pH, alkalinity, and several informational parameters. Other types of measurements that also may be necessary for specific projects include acid neutralizing capacity, reduction-oxidation potential (Eh), and turbidity. District procedures for collecting field measurements in surface- and ground-water systems are provided in chapter A6 of the National Field Manual (Wilde and Radtke, 1998). Field measurements should represent, as closely as possible, the natural conditions of the system at the time of sampling. To ensure quality of the measurements, calibration within the range of field conditions at each site is required for most instruments.

Field-measurement data must be recorded while in the field, including methods, equipment, and calibration information. Field-measurement data are stored on paper field forms, which may be national forms (fig. 8.1.1), or customized for a particular project. The QW Specialist and QW Coordinator are responsible for reviewing field records for completeness. To avoid the loss of data because of possible instrument malfunction, project chiefs or field personnel should ensure that backup sensors or instruments are readily available and in good working condition.



U.S. GEOLOGICAL SURVEY, WRD, SURFACE-WATER QUALITY FIELD NOTES

BQA-1 3/92 (3rd printing, 1st ed.)

Proj. Name, No. _____ Date _____

Station _____ Sta.No. _____

Sampled By _____ Mean Time _____ SMS Cntrl. No. _____

Record No. Sample Purpose (71999) :

SAMPLES COLLECTED

Nutrients ☐ TOC ☐
Major Ions ☐ DOC ☐
SOC ☐ Vol. Filt. _____mL
BOD ☐ Turbidity ☐
COD ☐ _____ ☐
_____ ☐

ORGANICS / TR. ELEMENTS

Pesticide ☐ Unfiltered ☐
VOC ☐ Filtered ☐
BNA ☐ Suspended ☐
_____ ☐ Bottom ☐

Sediment Conc. ☐
Sediment Size ☐
Sed. Bot. Material ☐
Sand Split/Break ☐
Radiochemical ☐
Isotope ☐
☐

LABORATORY SCHEDULES

Lab Schedules Req. (or copy of lab request form attached ☐)

Lab Codes Add (A) Delete (D) :

FIELD MEASUREMENTS

Q. Inst. (00061)	_____	cfs	meas. rating est.	Alkalinity ( )	_____ mg/L
Gage Ht (00065)	_____	ft.		Bicarbonate ( )	_____ mg/L
Temp. Water (00010)	_____	°C		Carbonate ( )	_____ mg/L
Temp. Air (00020)	_____	°C		Hydroxide ( )	_____ mg/L
pH (00400)	_____	units		E. Coli (31633)	_____ col./100 mL; Rmk
Sp. Cond. (00095)	_____	µS/cm 25 °C		FC (31625)	_____ col./100 mL; Rmk
Dis. Oxy. (00300)	_____	mg/L		FS (31673)	_____ col./100 mL; Rmk
DO Sat. (00301)	_____	%		Other:	
Bar. Press. (00025)	_____	mm Hg			

SAMPLING CONDITIONS

Location: Wading, cable, ice, boat, bridge, upstr., downstr., side bridge _____ft mile, above, below gage, and

Sampling site: Pool Riffle Open Channel Braided Backwater Sampler Type _____

Sample Method: EWI EDI OTHER _____ Sampler ID _____

Nozzle size _____ Nozzle Made of _____ Bottle type, size _____

Sample Split: Churn Cone Other _____ Made of _____

LB_____RB_____Stream Width_____ Sampling Pts. _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____ _____

Bottom: Bedrock Rock Cobble Gravel Sand Mud Concrete Other _____

Stage Conditions:
A Not Determined **4** Stable, low **5** Falling **6** Stable, high **7** Peak **8** Rising **9** **Stable, normal**

Hydrologic Event: **9** **Routine samp.** **A** Spg. breakup **B** Ice Cover **1** Drought **2** Spill **3** Reg. Flow **4** Snowmelt **7** Flood

Other _____ Ice Thickness _____ Ice cover _____

Stream color(s): brown green blue gray other _____

Stream Mixing: Excellent Good Fair Poor Clarity/Turbidity: _____

Weather: Clear Partly Cloudy Cloudy Light Medium Heavy Snow Rain Calm Light Breeze Very Gusty Windy Very Cold Warm Hot Other

Other Observations

Observations:
(Codes: 0-none 1-mild 2-moderate 3-serious 4-extreme)
(option: LEAVE BLANK IF NONE)

Floating debris	(01345) :	____
Floating garbage	(01320) :	____
Floating algae mats	(01325) :	____
Fish kill	(01340) :	____
Detergent suds	(01305) :	____
Turbidity	(01350) :	____
Atms. Odor	(01330) :	____
Oil-grease	(01300) :	____

Sampling	GHT	
Start Time	_____	_____
Mean Time =	_____	_____
	_____	_____
	_____	_____
End Time	_____	_____

(Cont. p. 3,4)

Checked by Date

Figure 8.1.1. Example first page of a national field form for use in recording field-measurement data.

To document the quality of field measurements, all District personnel involved in the collection of water-quality data are required to participate in the National Field Quality Assurance (NFQA) Program (Stanley and others, 1992). Results of the NFQA Program are reviewed by the Regional Hydrologist and the District QW Specialist. Staff receiving an unsatisfactory rating will receive a second round of testing, either by the NFQA or the District. If unsatisfactory rating occurs for the third time, then the field personnel and District QW Specialist will determine if additional training or instrument replacement is warranted.

When a contact observer for a water-quality station is hired, appropriate experienced field personnel from the project will provide on-site demonstrations and detailed written and verbal instructions for prescribed sampling techniques and for handling and shipment of samples. The specific conductance of samples collected by contract observers should be determined within one week after they are received. Field personnel will collect a "check" sample during each visit. The QW Specialist will compare the specific conductance and temperature readings with gage-heights and also with "check" values obtained during scheduled field trips to the stations. Any discrepancy noted during the review of the specific conductance, temperature, and gage-height data or during on-site inspection will be documented and the observer notified. Additional training will be provided as deemed necessary. The observer's contract will be terminated if his performance does not improve or is otherwise unsatisfactory.

8.1.2 Cleaning of Sampling and Processing Equipment

Procedures for cleaning equipment used for water-quality sampling and processing are described in chapter A3 of the National Field Manual (Wilde and others, 1998c). All new equipment acquired for water-quality sampling, as well as equipment that has been in long-term storage, must be cleaned in the office before being used in the field. Similarly, equipment must be cleaned as soon as possible after sample collection and before being used again to avoid cross-contamination between sampling sites. The field rinsing of equipment only with site water just prior to sample collection is not a substitute for proper cleaning.

Equipment blanks are a particular type of blank sample that is used to verify that cleaning procedures used by the field personnel are adequate for removing contamination. These blanks ensure that individual pieces of sampling equipment are not sources of detectable concentrations of constituents to be analyzed in environmental samples. An annual equipment blank, collected in the office laboratory, is required for each set of equipment used to collect water-quality samples (Horowitz and others, 1994; Wilde and others, 1998c, chap. A3). Annual equipment blanks that indicate detectable levels of constituents require submission of blanks for individual components of the equipment to isolate the source of contamination. When the source of contamination has been determined, the necessary maintenance must be performed to eliminate contamination, or the equipment must be replaced. The QW Specialist and QW Coordinator monitor the results of annual equipment blanks and ensure compliance with District standards.

8.1.3 Surface-Water Sampling

Collecting surface-water samples that accurately represent the physical and chemical characteristics of the aquatic system requires the appropriate use of sampling equipment and methods in order to describe environmental variability and to prevent contamination or bias in the sampling process. All District personnel who are involved in water-quality studies must be well informed of the various factors that must be considered to ensure the collection of representative samples. The choice of sampling equipment and method of sample collection are based on established protocols and guidelines, depending upon the characteristics of the target constituents, study objectives, hydrologic conditions, and sampling logistics.

8.1.3.1 Equipment Selection

Guidelines for selecting equipment for sampling surface water are provided in Horowitz and others (1994) and in chapter A2 of the National Field Manual (Wilde and others, 1998b). Review of equipment selection by District technical specialists occurs during proposal and work plan review and during periodic project reviews.

8.1.3.2 Sample Collection

Guidelines for the collection of surface-water samples are provided in chapter A4 of the National Field Manual (Wilde and others, 1999a). Field personnel are responsible for examining the sampling site carefully and choosing the most appropriate sampling method to generate the best sample possible under the conditions at the time of sampling. The standard procedure for stream sampling is to collect the sample through the entire depth of the water column at multiple vertical transects by either the equal-discharge or equal-width increment method. These procedures generate a representative cross-sectional sample that is both flow-weighted and depth- and width-integrated (Edwards and Glysson, 1988; Ward and Harr, 1990). Occasionally, the use of non-integrated or non-flow-weighted methods may be appropriate because of hydrologic, climatic, or safety conditions, or specific project objectives. Thorough documentation of sampling equipment and methods that are used is required in field records associated with water-quality samples. The QW Coordinator, project chiefs, and field personnel are responsible for timely review of field records.

Specific procedures employing two-person sampling teams with specific, designated roles in sample collection and handling are required when sampling for trace inorganic constituents with ambient concentrations less than about 10 parts per billion (ppb), as described in Horowitz and others (1994).

Review of surface-water sampling procedures for each District water-quality project is performed at least annually by the QW Specialist and is documented with a memorandum to the appropriate project chief and the District Chief. An independent review of field methods, for at least one District project, is conducted once every 3 years during the Office of Water Quality District technical review.

8.1.4 Use of Automated Samplers

Automated samplers are typically recommended for data collection activities in which hydrologic conditions change too rapidly for District personnel to adequately mobilize and sample. For example, automated samplers would be deployed for collecting samples from small streams during storm events. These automated samplers should be treated much the same way as point samplers. The following sections outline recommended practices for equipment selection and sample collection.

8.1.4.1 Equipment Selection

Currently, there are no technical memoranda concerning the selection of automated samplers by the Office of Water Quality. Review of equipment selection by District technical specialists occurs during proposal and work plan review and during periodic project reviews.

8.1.4.2 Sample Collection

Automated sampler intake lines should be placed at a well-mixed location (centroid) of flow to adequately pump samples for rapidly changing stream conditions. An adequate number of depth- and cross-sectional integrated samples should be collected by District personnel in order to relate the water quality as determined by samples from the automated (point) sampler to the water quality of the entire cross section.

Sampler tubing and bottles should be selected according to data quality objectives of the specific project. For example, if automated samplers are used to collect samples for low level detection organics or trace metals, then Teflon tubing and Teflon or glass bottles should be used. Sampler lines should be rinsed during and after sampling events to insure that water from a previous event does not contaminate water from future events. The automated samplers can typically be programmed to back-flush the sampler lines during with native water prior to pumping each sample. However, the sampler lines may require rinsing between storm events with appropriate reagents.

Appropriate QC samples should be taken for each sampler. Laboratory-assured blank water should be pumped throughout the system simulating an actual pumping of a storm sample to determine possible contamination in the pump lines. Should contamination be detected, then each segment of the pump systems should be broken down and blank water samples taken to determine where the contamination occurs. Then, appropriate corrective actions should be taken to eliminate the contamination or to document the levels of contamination if they cannot be eliminated. Also, other QC samples such as split replicates should be taken as well according to OWQ technical memoranda presented elsewhere in this document.

In all cases, it is recommended that project chiefs that plan to use automated samplers consult with the District QW Specialist on matters of sampler equipment, intake line placement, QC samples, and so forth prior to their use.

8.1.5 Ground-Water Sampling

District ground-water sampling procedures are designed to ensure that the samples collected are representative of water in the aquifer and are not contaminated by well construction material or sampling equipment, and that the composition of the samples is not altered by physical or chemical processes during sampling. It is critical that field personnel be aware of all factors that can compromise the integrity of ground-water samples and implement consistent strategies to protect sample integrity.

8.1.5.1 Equipment Selection

Guidelines for selecting appropriate equipment for ground-water sampling are provided in the National Field Manual (Wilde and others, 1998b, chap. A2). All project personnel involved in ground-water sampling for water-quality studies must understand the advantages and disadvantages of available equipment with respect to study objectives. Because of the wide range of factors involved, the ideal equipment for sample collection under some circumstances may not exist. When compromise decisions are required, the field team must thoroughly document with field notes the compromises that are made. Review of equipment selection occurs during proposal and work plan review and during periodic project reviews by District technical specialists.

8.1.5.2 Sample Collection

Guidelines, which prevent or minimize loss of sample integrity, for collecting representative water-quality samples from ground water are provided in chapter A4 of the National Field Manual (Wilde and others, 1999a). The standard procedure for ground-water sampling is to purge the well to remove at least three well volumes of standing water while monitoring field measurements for stabilization. However, exceptions to the three-well-volume rule can be made under some circumstances, depending upon project objectives or site characteristics. The QW Coordinator, project chiefs, and field personnel are responsible for timely review of field records.

As a rule, field personnel are required to follow a prescribed order of sample collection, described in the National Field Manual (Wilde and others, 1999a, chap. A4, table 4-5), to help ensure the quality of the data collected. In addition, two-person sampling teams are to implement coordinated clean-handling techniques when collecting samples for trace elements with concentrations less than about 10 ppb, as described in Horowitz and others (1994).

Review of ground-water sampling procedures for each District water-quality project is performed at least annually by the QW Specialist and documented with a memorandum to the appropriate project chief and the District Chief. An independent review of field methods, for at least one District project, is conducted once every 3 years during the Office of Water Quality District technical review.

8.1.6 Precipitation Sampling

Specific procedures in the Mississippi District for collecting precipitation samples are based primarily on the study objectives. Major factors that must be considered in sampling for precipitation quality include the location of the sampling station relative to human influences, the choice of sampling equipment, and special sample-handling procedures that may be necessary. Precipitation-quality sampling equipment should be composed of inert, nonabsorbent material that will not affect the typically low concentrations of ions in solution.

Guidelines regarding the collection of precipitation samples are provided in the following references:

1. OWQ Technical Memorandum 81.07 for guidance in field and laboratory procedures in the WRD;
2. Peden and others (1986) for procedures for collecting precipitation samples recommended by the USEPA; and
3. Willoughby (1995) for a case study discussing methods of precipitation sampling and analysis.

The project proposal and work plan should be consulted for specific guidelines regarding the factors that must be considered in choosing the sample location, the sampling equipment and frequency, and the special sample handling procedures that may be necessary based upon the study objectives.

The Mississippi District has precipitation sampling stations as part of NADP. Guidelines and procedures for sampling are determined by NADP. For specific questions related to precipitation sampling that are not addressed by these references, contact the NADP Coordinator.

8.1.7 Sample Processing

All samples collected for water-quality analysis must be processed according to procedures in the National Field Manual (Wilde and others, 1999b, chap. A5) as soon as possible following collection. The constituents of interest and study objectives determine the specific processing procedures that are necessary, which must be described in the project work plan.

All District water-quality studies that include the analysis of trace elements in concentrations less than 10 ppb must use the protocols for sample processing as described in Horowitz and others (1994). These techniques require the use of processing and preservation chambers to reduce the potential for contamination from the surrounding environment during sample splitting, filtration, and preservation. Review of sample processing procedures for all water-quality projects occurs during proposal and work plan review and during periodic project reviews by the District QW Specialist.

8.1.7.1 Sample Compositing and Splitting

Guidelines for using sample compositors and splitters are in the National Field Manual (Wilde and others, 1998b, chap. A2). Two types of sample splitters presently in use in the WRD are

the churn splitter, which also serves as a compositing device, and the cone splitter, which requires a separate compositing vessel. Each splitter has specific advantages and disadvantages, as described in OWQ Technical Memorandum 97.06. Either splitting method can be applied to inorganic and organic constituents within the technical design limits of the device and as long as the equipment is constructed of appropriate materials.

8.1.7.2 Sample Filtration

Filtration is required for many water-quality samples in order to separate particulates from the water and constituents in solution. Selection of the appropriate filter unit and filter characteristics to be used depends on the constituent class of interest and is based on guidance provided in the National Field Manual (Wilde and others, 1998b, chap. A2). Guidelines for filtration procedures for specific constituent groups are provided in the National Field Manual (Wilde and others, 1999b, chap. A5). For surface water, the most common filtration system consists of a reversible, variable-speed battery-operated peristaltic pump and 0.45-micron pore size disposable capsule filter for inorganics and glass fiber filter (GFF) for pesticides. For ground water, the sample is generally pumped directly from the well through a 0.45- micron pore size disposable capsule filter. Filtration of samples for analysis of trace elements in concentrations less than 10 ppb must be done in a processing chamber that encloses the filtering unit and sample bottles in a protected environment.

8.1.7.3 Sample Preservation

Sample preservation techniques are required for some constituent groups to prevent reduction or loss of target analytes and to stabilize analyte concentrations for a limited time. Guidelines for sample preservation are provided in the National Field Manual (Wilde and others, 1999b, chap. A5), and the NWQL Services Catalog (see section 4.3.1 for location). Since some samples have a very limited holding time even when preserved, field personnel must ensure that all water-quality samples are shipped to the laboratory as quickly as possible and that time-sensitive samples are received in good condition within the appropriate holding time. For details on sample shipping requirements, refer to the next section of this QA plan. The Mississippi District is notified by the shipping contractor or laboratory personnel when shipping problems such as packaging problems, temperature problems, and lengthy holding times occur.

8.2 Other Types of Water-Quality Samples

Many water-quality studies in the WRD are beginning to employ a multidisciplinary approach that relies on data from a range of sampling media. A variety of different types of biological, sediment, and radiochemical samples may be incorporated into a water-quality project in order to provide multiple lines of evidence with which to evaluate a particular aquatic system. This section of the QA plan includes an overview of standard District QA procedures and references for detailed instructions that describe the collection of biological, sediment, and radiochemical samples.

8.2.1 Biological Sampling

District water-quality activities include the collection of biological samples. Guidelines and QA procedures for biological sampling are based on the National Field Manual, NAWQA guidelines, and the references listed below. Biological samples include sampling for bacteria,; biological oxygen demand; chlorophyll, algae, including phytoplankton or periphyton; benthic invertebrates; fish; and contaminants in biological tissues. Measurements related to biological condition also may include evaluations of stream habitat.

8.2.1. Summary of references for collecting and processing biological samples

Reference	Sample type
Crawford and Luoma, 1994	Contaminants in tissues
Cuffney and others, 1993	Benthic invertebrates
Meador and others, 1993	Fish
Meador, Hupp, and others, 1993	Stream habitat
Myers and Wilde, 1997 (TWRI book 9, chap. A7)	Bacteria; biological oxygen demand
Porter and others, 1993	Algae

8.2.2 Suspended-Sediment and Bottom-Material Samples

District water-quality activities include the collection of suspended-sediment and bottom-material samples. Guidelines for the collection of sediment samples are described in selected WRD publications and in WRD Office of Surface Water (OSW) memoranda, which are referenced below. Suspended-sediment samples are typically analyzed by the Louisiana District sediment laboratory for concentration and either sand and silt distribution or complete particle-size distribution. Samples for both suspended sediment and bottom sediment may be analyzed for chemical constituents, including trace elements or hydrophobic organic compounds.

Field personnel must be familiar with the factors involved in the selection of sediment-sampling equipment that are based on the type of analyses to be performed and hydraulic conditions, as well as special cleaning procedures that may be required when sampling sediment chemistry. The project work plan should be consulted for specific guidelines for sediment sampling, depending on project objectives.

Individuals who have questions regarding the collection and handling of sediment samples should contact the QW Specialist. For particular questions concerning sediment chemistry samples, contact the QW Specialist.

Table 8.2.2. Summary of references for collecting suspended-sediment samples

Reference	Subject
District sediment laboratory QA plan	Laboratory procedures used in processing and analyzing sediment samples.
Edwards and Glysson, 1988	Field methods for measurement of fluvial sediment.
Guy, 1969 (TWRI book 5, chap. C1)	Laboratory theory and methods for sediment analysis.
Knott and others, 1992	Quality-assurance plan for collecting and processing sediment data.
OSW Memorandum 93.01 (USGS)	Instrumentation and field methods for collecting suspended-sediment data.
Radtke, 1998 (TWRI book 9, chap. A8)	Collecting and processing bottom-sediment samples.
Shelton and Capel, 1994	Collecting and processing streambed-sediment samples.
Wilde and others, 1998c (TWRI book 9, chap. A3)	Cleaning equipment for sampling suspended-sediment chemistry.
Wilde and others, 1998b (TWRI book 9, chap. A2)	Selection of equipment for sampling suspended-sediment chemistry.

8.3 Quality-Control Samples

Quality-control samples must be collected as integral components of all District water-quality studies to determine the acceptability of performance in the data-collection process and provide a basis for evaluating the adequacy of procedures that were used to obtain data. Guidelines for the collection of specific types of QC samples and the use of QC data are provided in the National Field Manual (Wilde and others, 1999a, chap. A4). Issues of QC sample design are addressed in section 3.2 of this plan. Specific guidelines for the collection and processing of QC samples must be included in the project work plan. The project chief is responsible for reviewing QC data in a timely manner and implementing necessary modifications, when appropriate, to sampling and processing techniques. The District QW Specialist has the responsibility for advising District personnel regarding the collection and interpretation of QC samples.

8.4 Safety Issues

Because the collection of water-quality data in the field can be hazardous at times, the safety of field personnel is a primary concern. Field teams often work in areas of high traffic, remote locations, and under extreme environmental conditions. Field work involves the transportation and use of equipment and chemicals and commonly requires working with heavy machinery. Additionally, field personnel may come in contact with waterborne and airborne chemicals and pathogens while sampling. Beyond the obvious concerns regarding unsafe conditions for field personnel, such as accidents and personal injuries, the quality of the data also may be compromised when sampling teams are exposed to dangerous conditions.

So that personnel are aware of and follow established procedures and protocols that promote all aspects of safety, the District communicates information and directives related to safety to all personnel. In-house training classes, memoranda, videotapes, and other actions as appropriate are used to communicate this information to District personnel. Specific policies and procedures related to safety can be found in the District safety plan.

An individual has been designated as Safety Officer by the District. The duties of the Safety Officer include both in-house and field-level training relative to safety for water-quality activities. Personnel who have questions or concerns pertaining to safety, or who have suggestions for improving some aspects of safety, should direct those questions, concerns, and(or) suggestions to the Safety Officer. Guidelines pertaining to safety in field activities are provided in the National Field Manual (Lane and Fay, 1998, chap. A9).

8.5 References Used for the Sample Collection and Processing Section

The following table lists reports and(or) memoranda referred to in this section. For a complete citation, refer to Section 13.0 of the report.

Table 8.5. Summary of references used for collecting and processing water-quality samples

Reference	Subject
Crawford and Luoma, 1994	Collecting samples of contaminants in tissue (NAWQA).
Cuffney and others, 1993	Collecting benthic invertebrate samples (NAWQA).
Edwards and Glysson, 1988	Representative sampling techniques for surface water.
Guy, 1969	Laboratory theory and methods for sediment analysis.
Horowitz and others, 1994	Protocol for collecting and processing inorganic constituents at ppb concentrations.
Knott and others, 1992	Quality-assurance plan for collecting and processing sediment data.
Koterba and others, 1995	Collecting and processing ground-water samples (NAWQA).
Lane and Fay, 1998 (TWRI book 9, chap. A9)	Safety in field activities.
Meador and others, 1993	Collecting fish samples (NAWQA).
Meador, Hupp, and others, 1993	Characterization of streambed habitat (NAWQA).
Myers and Wilde, 1997 (TWRI book 9, chap. A7)	Collecting biological samples.
OSW Memorandum 93.01 (USGS)	Instrumentation and field methods for collecting suspended-sediment data.
OWQ Memorandum 81.07 (USGS)	Field and laboratory procedures for precipitation samples.
OWQ Memorandum 97.06 (USGS)	Comparison of splitting capabilities of the churn and cone splitters.
Peden and others, 1986	Procedures for collecting precipitation samples, recommended by USEPA.
Porter and others, 1993	Collecting algal samples (NAWQA).
Radtke, 1998 (TWRI book 9, chap. A8)	Collecting and processing bottom-sediment samples.
Shelton, 1994	Collecting and processing stream-water samples (NAWQA).
Shelton and Capel, 1994	Collecting and processing streambed-sediment samples (NAWQA).
Stanley and others, 1992	National field quality-assurance program.
Ward and Harr, 1990	Representative sampling techniques for surface water.
Wilde and Radtke, 1998 (TWRI book 9, chap. A6)	Well-purging procedures.
Wilde and others, 1998c (TWRI book 9, chap. A3)	Cleaning equipment used to collect and process water-quality samples.
Wilde and others, 1999a (TWRI book 9, chap. A4)	Collecting water-quality samples from surface and ground water.
Wilde and others, 1999b (TWRI book 9, chap. A5)	Processing water-quality samples.
Wilde and others, 1998b (TWRI book 9, chap. A2)	Selection of equipment used to collect and process water-quality samples.
Willoughby, 1995	Case study discussing methods of precipitation sampling and analysis.

9.0 WATER-QUALITY SAMPLE HANDLING AND TRACKING

All water-quality samples must be uniquely identified, documented, handled, shipped, and tracked appropriately. Following proper protocols for sample handling, shipping, and tracking ensures that samples are processed correctly and expeditiously to preserve sample integrity between the time of collection and the time of analysis. This section describes the procedures used by the Mississippi District for handling, shipping, and tracking samples from collection through transfer of the samples to an analytical facility. Receipt of analytical data from laboratories is covered in Section 10.0 (Water-Quality Data Management).

9.1 Preparation for Sampling

Ensuring that field personnel have the correct equipment and supplies on hand to perform the necessary sampling activities saves time and labor costs associated with repeated sampling trips that result from inadequate planning. Therefore, before commencing field activities, the project chief or field personnel is responsible for ensuring that the following preparations have been completed:

- Review the sampling instructions for each site and the list of sample types required.
- Provide the QW Coordinator with station information for the NWIS Site-Inventory File prior to first sampling trip.
- Prepare bottle labels for samples.
- Obtain field sheets or notebooks and analytical services request forms (ASR's) from the QW Coordinator before each trip.
- Ensure that necessary supplies are available, such as bottles, standards, filters, preservatives, meter batteries, waterproof markers, and shipping containers (see section 5.1.3 (Equipment and Supplies).
- Ensure that all sampling equipment is thoroughly cleaned and prepared.
- Check meters and sensors for proper performance.

9.2 Onsite Sample Handling and Documentation

During a sampling trip, it is imperative that accurate notes be taken and that sample bottles be labeled and handled appropriately for the intended analysis. Otherwise, bottle mix-ups or other errors may occur, and the samples may be wasted. The project chief and field personnel are responsible for ensuring that all of the following sampling requirements are implemented (Wilde and others, 1999b, Chap A5, sec. 5.5):

1. ASR forms are filled out as samples are collected and processed.
2. Sample labels include at least but not limited to the following: (a) field sample ID; (b) date and time; and (c) sample type – for example, RCA, raw-chilled, acidified.
3. Sample labels should be written and attached in such a way as to prevent their accidental destruction during shipping due to moisture.

9.3 Sample Shipment and Documentation

Upon completion of a sampling trip, samples should be packaged and shipped to the laboratory for analysis as soon as possible. Generally, the shorter the time between sample collection and processing and sample analysis, the more reliable the analytical results will be. Before shipping samples to the laboratory, the project chief or field personnel should complete the following:

1. Check that sample sets are complete and that sample bottles are labeled correctly, with all required information (see Section 9.2).
2. Complete the ASR's for all samples being sent to the NWQL. If samples are being sent to a different, approved laboratory, information similar to that required on the ASR's should be provided to the laboratory.
3. Pack samples carefully in shipping containers to avoid bottle breakage, shipping container leakage, and sample degradation. Check that bottle caps are securely sealed. Follow the packing and shipping protocols established by the USGS and the receiving laboratory (NWQL Technical Memorandum 95.04; National Field Manual).
4. Ship samples after sample collection and the same day whenever possible. Refer to the National Field Manual (Wilde and others, 1999b, chapter A5) for guidance.

9.4 Sample Tracking Procedures

The District maintains a record of all samples collected and shipped to a laboratory for analysis to ensure the complete and timely receipt of analytical results. The QW Coordinator has responsibility for recording the required information. The QW Coordinator has responsibility for reviewing the tracking log to determine if analyses are missing and for taking corrective action(s) if necessary.

9.5 Chain-of-Custody Procedures for Samples

When chain-of-custody procedures are appropriate or required (for example, when data may be used in legal proceedings), the project chief and QW Coordinator should establish, maintain, and document a chain-of-custody system for field samples that is commensurate with the intended use of the data. A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. Every exchange of a sample between people or places that involves a transfer of custody should be recorded on appropriate forms that document the release and acceptance of the sample. Each person involved in the release or acceptance of a sample should keep a copy of the transfer paperwork. The project chief, or designee, is responsible for ensuring that custody transfers of samples are performed and documented according to the requirements listed below:

- The means for identifying custody should be clearly understood (use of forms, stickers);
- Instructions for documenting the transfer of samples and the person responsible for this documentation must be clearly defined; and
- A plan must be in place for maintaining records in a specific location for a specific period of time (for example, in the site folder).

Since laboratories should have their own internal chain-of-custody requirements, it is probably not necessary to include information on their procedures. However, individual projects may need laboratory chain-of-custody documentation, but this can be documented in a project work plan.

9.6 References Used for the Sample Handling and Tracking Section

The following table lists reports and(or) memoranda referred to in this section. For a complete citation, refer to Section 13.0 of the report.

Table 9.6. Summary of references for handling and tracking water-quality samples

Reference	Subject
NWQL Memorandum 95.04	Shipping samples to the NWQL, and instructions for filling out Analytical Services Request (ASR) forms.
Wilde and others, 1999b (TWRI book 9, chap. A5)	Processing water samples.

10.0 WATER-QUALITY DATA MANAGEMENT

Water-quality data that are collected for hydrologic investigations are recorded on paper and electronically. Data that are recorded on paper include chemical, physical, biological, and ancillary data measured in the field. This information is documented on standard USGS field forms (fig. 8.1.1) and stored in site files. Data that are recorded electronically include analytical results and continuous monitoring data transmitted over the computer network or stored by electronic data logger. Data that are recorded on paper and electronically typically are stored either in the NWIS QWDATA data base (Maddy and others, 1997) or in NWIS-ADAPS data base (Dempster, 1990). The NWIS is the storage medium for water-quality, streamflow, well, and water-use information collected by the USGS. Data that cannot be stored in these national data bases may be stored in other data bases, such as project data bases.

10.1 Processing Data

Sampling information, field determinations, and ancillary information are recorded on a set of water-quality field notes that are considered original record. These data are combined with analytical data from the laboratory in computer data files and paper files and are maintained by the QW Coordinator.

10.1.1 Continuous Monitoring Data

Continuous monitoring data are water-quality records collected onsite by electronic sensors and data loggers. Two methods for electronically recording data are by (1) transmitting data

from a remote location by land line or radio telemetry to a central location where they are recorded on disk and magnetic tape, and (2) recording data at a remote location on disk and magnetic tape. Initial data processing in the office is for the purpose of obtaining a copy of the original data for archiving (see Section 10.4). Data are not manipulated by the field instrument or a computer except to convert recorded signals into data in commonly used units or to display data in a convenient format. The transfer of data from the electronic storage medium to NWIS requires thorough checking to ensure that the data have transferred successfully or that as much data as possible have been recovered and errors identified (WRD Memorandum 87.085).

Data collected from continuous monitors are either transmitted via satellite or transferred by disc directly into NWIS with automated decoding. District field personnel visit sites frequently to check calibration. Appropriate steps are taken to adjust raw data based on field calibration.

10.1.2 Analytical Data

Analytical data are results of field and laboratory chemical, physical, or biological determinations. Most water-quality samples are analyzed either in the field or at the NWQL or Ocala Water-Quality Services Unit. In some cases, samples may be analyzed by research laboratories or by laboratories outside of the USGS (see Section 4.1).

In order to enter analytical data into the NWIS data base, a site identification number must first be assigned and entered into the District site file (see Section 7.2). Field measurements are entered into the NWIS data base by the QW Coordinator as soon as possible after returning from the sampling field trip. A record number is assigned by the system and is recorded on the field sheet. Record numbers are recorded on field forms stored in project files by the QW Coordinator (see Section 9.4 for sample tracking.) Sample logging is required for data from the NWQL or QWSU to successfully transfer the data into the data base. Environmental sample data are entered into the District NWIS QWDATA [DB1]; QA data are entered into the District NWIS QWDATA [DB2].

All data from the NWQL and QWSU are electronically transferred to the appropriate District data base by the QW Coordinator at least once per week. Hard copies of the analytical reports (WATLIST's) are forwarded to the QW Specialist and project chief (if requested) for review and then stored in QW files maintained by the QW Coordinator. The NWIS QWDATA data base receives daily incremental backup and weekly full backup.

Data analyzed by laboratories other than the NWQL or QWSU must be entered into NWIS, if possible (Hubbard, 1992), and identified according to the analyzing laboratory. Data entry is the responsibility of the QW Coordinator. Data are entered and stored according to procedures already described for processing NWIS analytical data. Appropriate codes are used to identify the data as originating from non-USGS sources.

10.1.3 Non-National Water Information System Data Bases

Sometimes data collected by project personnel cannot be entered into the District NWIS QWDATA data base because NWIS cannot accept the type of data that are generated by the project (for example, taxonomic data). In these cases, project data bases may be established to accommodate the data storage requirements and formats. Project data bases that are the sole repository for project data should have a written procedure for data entry, storage, and long-term backup and archival. Project chiefs are to coordinate with their supervisor, the QW Specialist, and the QW Coordinator for developing and implementing management of project data bases.

10.2 Validation (Records Review)

Data validation is the process whereby water-quality and associated data are checked for completeness and accuracy. After validation, data records are finalized in the District data base.

10.2.1 Continuous Monitoring Data

Following the entry of continuous monitoring data into NWIS, raw data and(or) graphs of raw data are reviewed by project chiefs and field personnel for anomalous values, dates, and times, and preliminary updating is done. Once the data are edited, the record is submitted to the QW Specialist (and to colleague review when necessary) for final review and approval.

10.2.2 Analytical Data

All field notes and field measurements are reviewed for completeness and accuracy within 7 days or as soon as possible after returning from the field trip by project chief and the QW Coordinator. All chemical analyses are reviewed for completeness, and questionable values are noted. Prompt review is necessary to allow analytical re-analysis to be performed before sample holding times have been exceeded for accuracy and precision. As soon as analytical results are pulled by the QW Coordinator, a hard copy is given to the project chief or the QW Specialist for review to identify potential samples that require re-analysis. Every data analysis entered into NWIS QWDATA results in output (WATLIST) that includes a copy of the analysis and a report of general validation checks (Maddy and others, 1997), including but not limited to the following:

- Comparison of determined and calculated values for dissolved solids,
- Comparison of dissolved constituents and total constituents,
- Comparison of specific conductance with dissolved solids,
- Comparison of constituents with relevant Federal drinking-water standards, and
- Comparison of sum of cations with sum of anions (ion balance).

Field and laboratory analyses, such as pH, specific conductance, and alkalinity, are compared to confirm agreement of independent measurements. If data from more than one sample are available for a site, the analysis also is compared with previous analyses within a hydrologic context to identify obvious errors, such as decimal errors, and possible sample mix-ups or anomalies warranting analytical re-analysis. These reports and comparisons are reviewed and noted on the analytical report (WATLIST). If necessary, corrections or re-analysis may be

requested by the QW Specialist.

Requests to the NWQL for re-analysis are made by email to DENQC (NWQL Memo 92-06); rerun requests to QWSU are made by email to OCALAMAN; and by email or phone to other laboratories as stipulated in the laboratory contract. Re-analysis requests are logged and tracked by the QW Coordinator (fig. 10.2.2.). Corrections to NWIS resulting from reruns by the NWQL must be made to the laboratory data base as well as to the District data base and are made by the QW Coordinator by email request to DENADP.

Date requested	Lab ID number	Station number	Date	Time	Parameter number	Parameter name	Old value	New value	Update No update/ Delete

Figure 10.2.2. Example of re-analysis request form.

Project QA data, such as blanks, replicates, blind standards, and matrix spikes, periodically are tabulated or graphed by the QW Specialist or project chiefs to facilitate identification of inaccuracies or systematic bias that may not be discernible when reviewing an individual analysis. Corrective actions can include deleting questionable values or values in error from the data base upon approval by the QW Specialist. All personnel responsible for sample collection and field analysis participate in the NFQA Program and process an equipment blank once per year. District QA data, including NFQA sample results and annual equipment blanks, are reviewed by the QW Specialist.

10.3 Data Storage

In accordance with WRD policy, all water data collected as part of routine data collection by the WRD are stored in the NWIS computer data base. Data collected by others, such as cooperators, universities, or consultants, which are used to support published USGS documents and are not published or archived elsewhere, also should be entered into NWIS and identified according to analytical laboratory and collection organization. Other outside data may be entered into the data base at the discretion of the QW Specialist if data-collection methods and quality have been reviewed and found acceptable. Electronically stored data that cannot be entered into NWIS are stored in project data bases online or offline. The Systems Administrator has responsibility for maintaining backups of data stored electronically in NWIS or online. Data stored electronically offline are maintained by project chiefs.

In addition to electronically stored data, other project data and information, including field

notes, ASR's, and WATLIST's, are retained in station folders and maintained by the QW Coordinator in the QW files. ASR forms and field forms are to be given to the QW Coordinator for every sample collected and stored in a "pending" folder. After all analytical results are received, a hard copy is made available to the QW Specialist and the project chiefs (when necessary) of the complete results of that particular sample. After review and approval by the QW Specialist, data are entered into NWIS and finalized. Hard copies of all samples for the current water year are fields in the offices of the QW Coordinator and are made available to project chiefs as requested. Hard copies of samples prior to the current water year are field in the District QW files.

10.4 Records Archival

According to WRD policy, all original data that are published or support published scientific analyses shall be placed in archives (WRD Memorandum 92.059; Hubbard, 1992). Original data—from automated data-collection sites, laboratories, outside sources, and non-automated field observations—are unmodified data as collected or received and in conventional units (engineering units, generally with a decimal). Original data should be preserved in this form, no matter how they may be modified later (Hubbard, 1992). Original data on paper include field notes, field measurements, ASR's, WATLIST's, continuous water-quality monitoring records, and calibration notes. These data are archived no later than when the project is completed or terminated. It is the responsibility of the project chief to work with the QW Coordinator to ensure that project files entered into the District archive are organized and complete. The District archive is located in the District offices and is maintained by QW Coordinator.

10.5 References Used for the Water-Quality Data Management Section

The following table lists reports and(or) memoranda referred to in this section. For a complete citation, refer to Section 13.0 of the report.

Table 10.5. Summary of references for managing water-quality data and records

Reference	Subject
Dempster, 1990	NWIS ADAPS user's guide.
Hubbard, 1992	Policy recommendations for managing and storing hydrologic data.
Maddy and others, 1997	NWIS QWDATA user's guide.
NWQL Memorandum 92.06 (USGS)	District rerun requests.
WRD Memorandum 87.085 (USGS)	Policy for collecting and archiving electronically recorded data.
WRD Memorandum 92.059 (USGS)	Policy for the management and retention of hydrologic data.

11.0 PUBLICATION OF WATER-QUALITY DATA

Water-quality data are published in hydrologic data reports or interpretive reports. The

selection of the appropriate publication outlet for water-quality data will be the responsibility of the project chief, the supervisor, and the QW Specialist. A summary of USGS and WRD policies pertaining to the publication of data and interpretive reports is contained in the WRD Publications Guides (Alt and Iseri, 1986, p. 382-385; U.S. Geological Survey, 1995). Other references that should be consulted when writing reports include "Suggestions to Authors ..." (Hansen, 1991) and the U.S. Government Printing Office Style Manual (U.S. Government Printing Office, 1984).

11.1 Hydrologic Data Reports

All non-proprietary water-quality data collected during the water year and stored in NWIS are published in the WRD annual data report, "Water Resources Data, Mississippi, Water Year ___." Hydrologic data reports make water-quality data available to users, but without interpretations or conclusions. Approval of hydrologic data reports is in accordance with applicable WRD, Region, and District policy (Alt and Iseri, 1986; May 8, 2000 memorandum from regional hydrologist, Southeast Region).

11.2 Interpretive Reports

Interpretive reports include such USGS outlets as Circulars, Professional Papers, Fact Sheets, Water-Resources Investigations Reports, and Open-File Reports, as well as non-USGS outlets, such as scientific journals, books, and proceedings of technical conferences. The District Water-Quality Specialist, project supervisor, and outside technical specialists will provide guidance in ensuring that each water-quality report meets the highest technical standards. Approval of interpretive reports is in accordance with applicable WRD, Region, and District policy (WRD Memorandum 95.18) and is more technically rigorous than the required approval for non-interpretive data reports (May 8, 2000 memorandum from regional hydrologist, Southeast Region).

11.3 Other Data Outlets

Article 500.14.1 of the Department of the Interior Geological Survey Manual (U.S. Department of the Interior, 1992) states that data and information are released through publications; however publication is not limited to paper media (WRD Memorandum 90.030; U.S. Department of the Interior, 1993). Electronic outlets include the internet and computer storage media, such as CDROM.

The term "data" refers to un-interpreted observations or measurements, usually quantitative measurements resulting from field observations and laboratory analyses of water, sediment, or biota. Data can be released to the public after preliminary review for accuracy by appropriate WRD personnel (WRD Memorandum 90.030). Constituents in water samples collected by or for the USGS that exceed USEPA drinking water maximum contaminant levels (MCL's), as

specified in the National Primary Drinking Water Regulations, are promptly reported by QW Specialist to appropriate agencies that have a need to know (WRD Memorandum 90.038).

The term “information” refers to interpretations of data or conclusions of investigations. Interpretive results or conclusions require colleague review and Director’s approval (or approval by delegated persons such as the Regional Reports Specialist) for publication.

11.4 References Used for the Publication Section

The following table lists reports and(or) memoranda referred to in this section. For a complete citation, refer to Section 13.0 of the report.

Table 11.4. Summary of references for publishing data

Reference	Subject
Alt and Iseri, 1986	Guide for publishing WRD reports.
Hansen, 1991	Suggestions to authors of USGS reports.
U.S. Department of the Interior, 1992	Safeguard and release of USGS information.
U.S. Department of the Interior, 1993	Policy for release of computer data bases and computer programs.
U.S. Geological Survey, 1995	Guidelines on writing hydrologic reports.
U.S. Government Printing Office, 1984	Style manual for printed government documents.
WRD Memorandum 90.030 (USGS)	Policy for release of digital data.
WRD Memorandum 90.038 (USGS)	Policy for reporting maximum contaminant level exceedances.
WRD Memorandum 92.005 (USGS)	Extended delegation of authority to approve reports of certain categories for open- file release.
WRD Memorandum 95.18 (USGS)	Re-delegation of Director’s report approval authority to Regional Hydrologists.

12.0 WATER-QUALITY TRAINING AND REVIEWS

Periodic reviews of data-collection procedures are used to evaluate the effectiveness of training programs and to determine if technical work is being conducted correctly and efficiently. Such reviews also are used to identify and resolve problems before they become widespread and potentially compromise the quality of the data.

12.1 Training

Employee training is an integral part of water-quality activities, allowing current employees to maintain and enhance their technical knowledge and new employees to gain the specific skills needed to adequately perform their job. A well-documented training program not only ensures that samples are collected correctly by technically competent personnel, but also lends legal credibility to data and interpretations. Training is accomplished according to the following policies and protocols.

Individual training plans are developed by the supervisor and employee at least annually as

part of the performance review process. The District Training Officer is responsible for informing District staff about the availability of training—in-house, USGS, U.S. Government, and other sources of training. The Water-Quality Specialist provides recommendations and advice to supervisors and their staff as needed. The supervisor has authority and responsibility for approving training opportunities. In addition, staff are responsible for taking full advantage of the training provided.

Primary sources of water-quality training are USGS courses, usually taught at the National Training Center at the Denver Federal Center; Southeast Region regional training; and District seminars or in-house training courses. The Water-Quality Specialist plays an important role in providing in-District training. Training documents are maintained by the Training Officer in District personnel files and by the Personnel Office in Southeast Region.

12.2 Reviews

Reviews of water-quality data-collection activities are conducted annually for each individual in the District who is actively involved in water-quality data collection. Reviews are conducted in the field or laboratory by the QW Specialist.

Reviews are completed in a timely manner, and comments are documented by the reviewer in a memorandum to the immediate supervisor with a copy to the District Chief. Reviews address sample collection and processing techniques, compliance with WRD, OWQ, and District policies, the condition of the work environment (for example, the field vehicle), and any other activities pertaining to the collection of good quality data. When deficiencies are noted, the reviewer, in consultation with the Water-Quality Specialist, is responsible for outlining corrective actions. The immediate supervisor is responsible for ensuring that, once identified, corrective actions are implemented and completed in a timely manner.

13.0 REFERENCES

Alt, D.F., and Iseri, K.T., eds., 1986, WRD publications guide, v. 1. Publications policy and text preparation: U.S. Geological Survey, 429 p.

Arvin, D.V., 1995, A workbook for preparing surface-water quality-assurance plans for Districts of the U.S. Geological Survey, Water Resources Division: U.S. Geological Survey Open-File Report 94-382, 40 p.

Brunett, J.O., Barber, N.L., Burns, A.W., Fogelman, R.P., Gillies, D.C., Lidwin, R.A., and Mack, T.J., 1997, A quality-assurance plan for District ground-water activities of the U.S. Geological Survey: U.S. Geological Survey Open-File Report 97-11, 21 p.

Crawford, J.K., and Luoma, S.N., 1994, Guidelines for studies of contaminants in biological tissues for the National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 92-494, 69 p.

Cuffney, T.F., Gurtz, M.E., and Meador, M.R., 1993, Methods for collecting benthic

invertebrate samples as part of the National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 93-406, 66 p.

Dempster, G.R., Jr., comp., 1990, National Water Information System user's manual, v. 2, chap. 3, automated data processing system: U.S. Geological Survey Open-File Report 90-116 [variously paged].

Edwards, T.K., and Glysson, G.D., 1988, Field methods for measurement of fluvial sediment: U.S. Geological Survey Open-File Report 86-531, 118 p.

Francy, D.S., Jones, A.L., Myers, D.N., Rowe, G.L., Eberle, C.M., and Sarver, K.M., in press, Quality-assurance/quality-control manual for collection and analysis of water- quality data in the Ohio District, U.S. Geological Survey: U.S. Geological Survey Water-Resources Investigations Report 98-4057.

Guy, H.P., 1969, Laboratory theory and methods for sediment analysis: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. C1, 58 p.

Hansen W.R., ed., 1991, Suggestions to authors of the reports of the United States Geological Survey (7th ed.): Washington, D.C., U.S. Government Printing Office, 289 p.

Horowitz, A.J., Demas, C.R., Fitzgerald, K.K., Miller, T.L, and Rickert, D.A., 1994, U.S. Geological Survey protocol for the collection and processing of surface-water samples for the subsequent determination of inorganic constituents in filtered water: U.S. Geological Survey Open-File Report 94-539, 57 p.

Hubbard, E.F., 1992, Policy recommendations for management and retention of hydrologic data of the U.S. Geological Survey: U.S. Geological Survey Open-File Report 92-56, 32 p.

Knott, J.M., Glysson, G.D., Malo, B.A., and Schroder, L.J., 1992, Quality-assurance plan for the collection and processing of sediment data by the U.S. Geological Survey, Water Resources Division: U.S. Geological Survey Open-File Report 92-499, 18 p.

Koterba, M.T., Wilde, F.D., and Lapham, W.W,. 1995, Ground-water data-collection protocols and procedures for the National Water-Quality Assessment Program: Collection and documentation of water-quality samples and related data: U.S. Geological Survey Open-File Report 95-399, 113 p.

Lane, S.L., and Fay, R.G., eds., 1998, Safety in field activities, *in* National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A9, 71 p.

Maddy, D.V., Lopp, L.E., Jackson, D.L., Coupe, R.H., Schertz, T.L., and Garcia, K.T., 1997, National Water Information System users' manual, v. 2, chap. 2, water-quality system: U.S. Geological Survey, version 1.2, Sept. 11, 1997 [variously paged].

Meador, M.R., Cuffney, T.F., and Gurtz, M.E., 1993, Methods for sampling fish communities as part of the National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 93-104, 40 p.

Meador, M.R., Hupp, C.R., Cuffney, T.F., and Gurtz, M.E., 1993, Methods for characterizing stream habitat as part of the National Water-Quality Assessment Program: U.S.

Geological Survey Open-File Report 93-408, 48 p.

Mueller, D.K., Martin, J.D., and Lopes, T.J., 1997, Quality-control design for surface- water sampling in the National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 97-223, 17 p.

Myers, D.N., and Wilde, F.D., eds., 1997, Biological indicators, *in* National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A7, 49 p.

Peden, M.E., and others, 1986, Development of standard methods for the collection and analysis of precipitation: Cincinnati, Ohio, U.S. Environmental Protection Agency [variously paged].

Porter, S.D., Cuffney, T.F., Gurtz, M.E., and Meador, M.R., 1993, Methods for collecting algal samples as part of the National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 93-409, 39 p.

Pritt, J.W., and Raese, J.W., eds., 1995, Quality assurance/quality control manual—National Water-Quality Laboratory: U.S. Geological Survey Open-File Report 95-443, 35 p.

Radtke, D.B., 1998, Bottom-material samples, *in* National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A8, 59 p.

Schroder, L.J., and Shampine, W.J., 1992, Guidelines for preparing a quality-assurance plan for the District offices of the U.S. Geological Survey: U.S. Geological Survey Open-File Report 92-136, 14 p.

--------1995, Guidelines for preparing a quality-assurance plan for the District water- quality activities of the U.S. Geological Survey: U.S. Geological Survey Open-File Report 95-108, 12 p.

Shampine, W.J., Pope, L.M., and Koterba, M.T., 1992, Integrating quality assurance in project work plans of the U.S. Geological Survey: U.S. Geological Survey Open-File Report 92-162, 12 p.

Shelton, L.R., 1994, Field guide for collecting and processing stream-water samples for the National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 94-455, 42 p.

Shelton, L.R., and Capel, P.D., 1994, Guidelines for collecting and processing samples of streambed sediment for analysis of trace elements and organic contaminants for the National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 94-458, 20 p.

Stanley, D.L., Shampine, W.J., and Schroder, L.J., 1992, Summary of the U.S. Geological Survey National Field Quality-Assurance Program from 1979 through 1989: U.S. Geological Survey Open-File Report 92-163, 14 p.

U.S. Department of the Interior, 1992, Safeguard and release of U.S. Geological Survey data and information, *in* U.S. Geological Survey manual 500.14.1: U.S. Department of the Interior, Geological Survey, May 15, 1992, 3 p.

-------- 1993, Policy for release of computer data bases and computer programs, *in* U.S. Geological Survey manual 500.24.1: U.S. Department of the Interior, Geological Survey, April 9, 1993, 4 p.

U.S. Geological Survey, 1995, Guidelines for writing hydrologic reports: U.S. Geological Survey Fact Sheet FS-217-95, 4 p.

U.S. Government Printing Office, 1984, Style manual: Washington, D.C., U.S. Government Printing Office, 479 p.

Ward, J.R., and Harr, C.A., eds., 1990, Methods for the collection and processing of surface-water and bed-material samples for physical and chemical analyses: U.S. Geological Survey Open-File Report 90-140, 71 p.

Wilde, F.D., and Radtke, D.B., eds., 1998, Field measurements, *in* National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A6 [variously paged].

Wilde, F.D., Radtke, D.B., Gibs, Jacob, and Iwatsubo, R.T., 1998a, Preparations for water sampling, *in* National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A1 [variously paged].

-------- 1998b, Selection of equipment for water sampling, *in* National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A2 [variously paged].

-------- 1998c, Cleaning of equipment for water sampling, *in* National field manual for the collection of water- quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A3 [variously paged].

-------- 1999a, Collection of water samples, *in* National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A4 [variously paged].

-------- 1999b, Processing of water samples, *in* National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A5 [variously paged].

Willoughby, T.C., 1995, Quality of wet deposition in the Grand Calumet River watershed, northwestern Indiana, June 30, 1992–August 31, 1993: U.S. Geological Survey Water-Resources Investigations Report 95-4172, 55 p.

13.1 Internal Documents

The following USGS memoranda are available electronically on the Internet at the following site address (URL) http://water.usgs.gov/public/admin/memo/ :

Branch of Operations Technical Memorandum 91.01, February 5, 1991, Safety—Chemical-hygiene plan.

National Water-Quality Laboratory Memorandum 92.01, March 25, 1992, Availability of equipment blank water for inorganic and organic analysis.

National Water-Quality Laboratory Memorandum 92.06, August 12, 1992, District rerun requests.

National Water-Quality Laboratory Memorandum 95.04, December 2, 1994, Shipping samples to the National Water-Quality Laboratory.

Office of Surface Water Technical Memorandum 93.01, October 8, 1992, Summary of documentation that describes instrumentation and field methods for collecting sediment data.

Office of Water Quality Technical Memorandum 81.07, December 15, 1980, Programs and Plans—Field-collection and data-processing procedures for atmospheric deposition samples.

Office of Water Quality Technical Memorandum 92.01, December 20, 1991, Distilled/ deionized water for District operations.

Office of Water Quality Technical Memorandum 92.06, March 20, 1992, Report of committee on sample shipping integrity and cost.

Office of Water Quality Technical Memorandum 97.06, May 5, 1997 (corrected May 14, 1997), Comparison of the suspended-sediment splitting capabilities of the churn and cone splitters.

Office of Water Quality Technical Memorandum 98.03, Policy for the evaluation and approval of production analytical laboratories.

Water Resources Division Memorandum 82.028, January 21, 1982, Water Quality—Acceptability and use of water-quality analytical methods.

Water Resources Division Memorandum 87.085, September 18, 1987, Programs and Plans—Policy for the collection and archiving of electronically recorded data.

Water Resources Division Memorandum 90.030 (revised), March 5, 1990, Programs and Plans—Policy for release of digital data.

Water Resources Division Memorandum 90.038, April 23, 1990, Policy for reporting Maximum Contaminant Level exceedances.

Water Resources Division Memorandum 92.005, December 16, 1991, Publications—Extended delegation of authority to approve reports of certain categories for release to the open file.

Water Resources Division Memorandum 92.035, April 16, 1992, Policy of the Water Resources Division on the use of laboratories.

Water Resources Division Memorandum 92.036, April 16, 1992, Policy of the Water Resources Division on the use of laboratories by national water-quality programs.

Water Resources Division Memorandum 92.059, October 20, 1992, Policy for management and retention of hydrologic data of the U.S. Geological Survey.

Water Resources Division Memorandum 95.18, March 14, 1995, Publications—Re-delegation of Director's report approval authority to Regional Hydrologists.

Water Resources Division Memorandum 95.35, May 15, 1995, Programs and Plans—Transmittal of an instrumentation plan for the Water Resources Division and the hydrologic field instrumentation and equipment policy and guidelines.